Dynamic Modeling Issues

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Long subject - short time - go fast

Distinction between
- design of the equipment / control
- developing understanding of individual equipment
- developing understanding of power system behavior
- event reconstruction
- production of study results in volume

A model that is ideal / essential for one of these functions can be inappropriate, and a liability, with regard to another

The most important liability and caveat -

Adding detail to a model in many cases DOES NOT make it more accurate

In many cases great detail gives a non-expert observer a false impression as to the accuracy / credibility of a simulation result

Volume of data is so great that even a *very expert* observer is unlikely to find all errors in a given data file

An appropriately expert / familiar observer will, however, find critical bad data items on most occasions

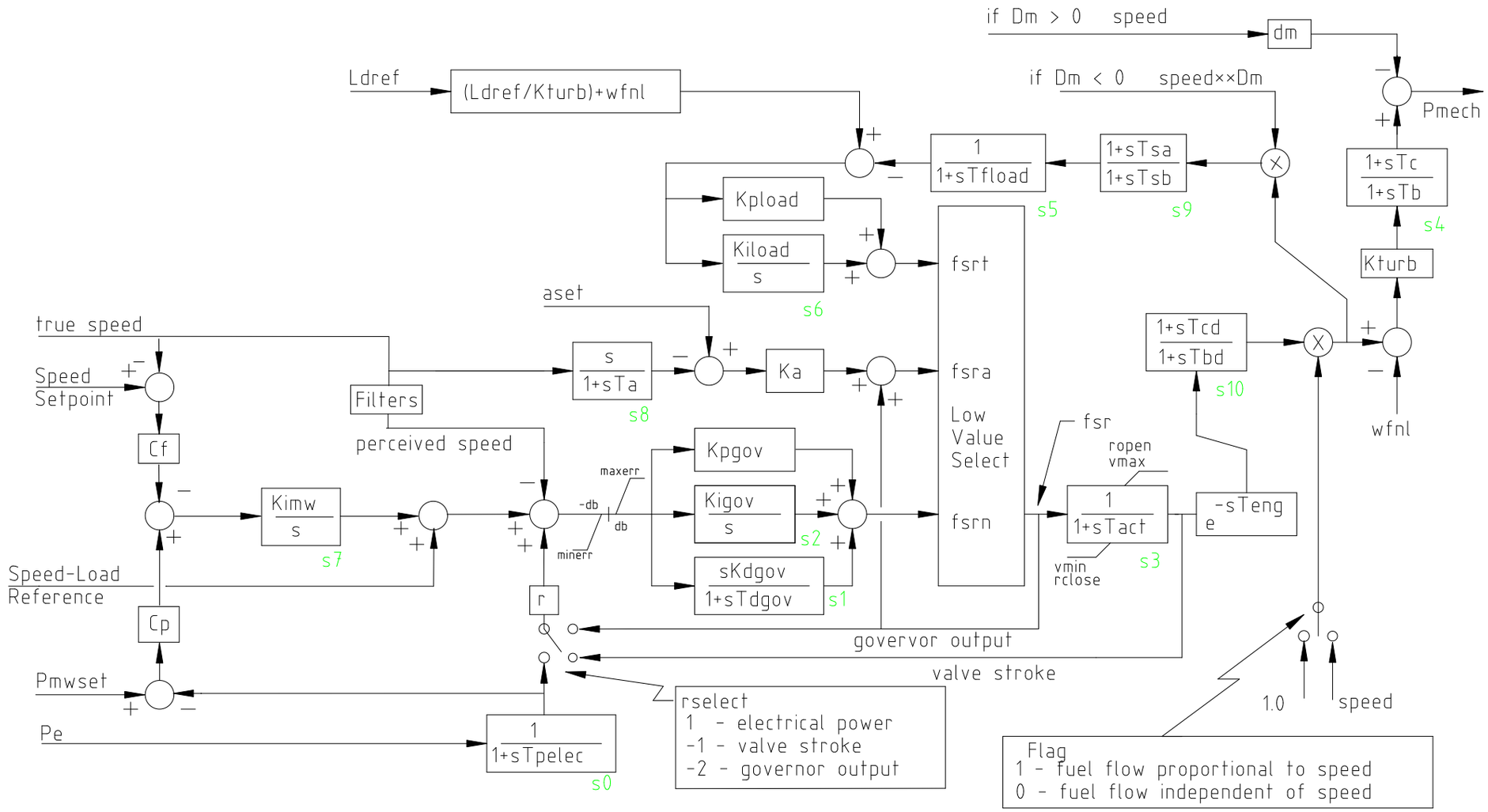
- *if given sufficient time, background, supporting information, and data assessment tools*

Modeling of the power system requires attention to BOTH :

The initial condition load flow
- line flows and voltage are important
- in-plant conditions must be credible

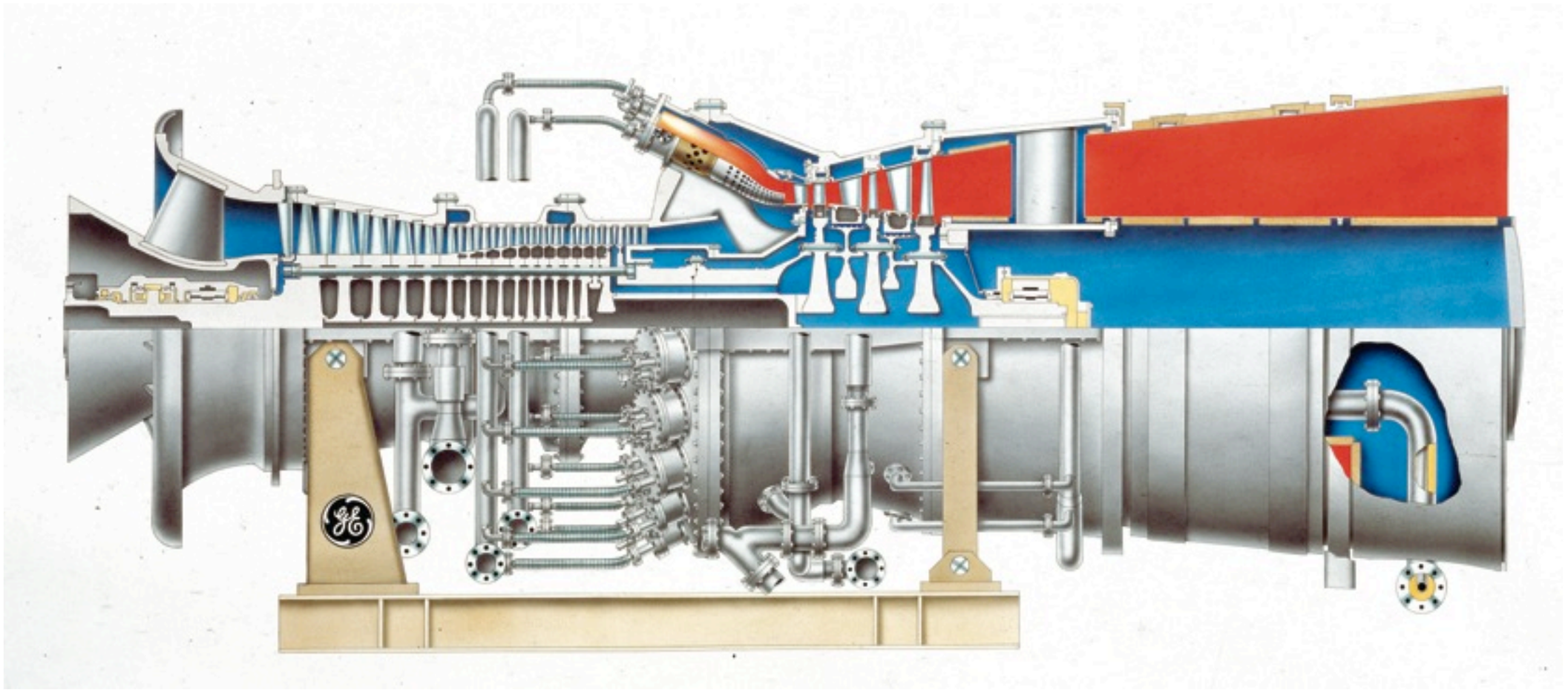
Dynamic model - parameters and usage
- PSLF/WECC parameter relationship checkers
- Knowledge of plant realities / capabilities
  - BOTH design / ratings / nameplates
  - AND operational practices

ggov3 Turbine-Controller Model

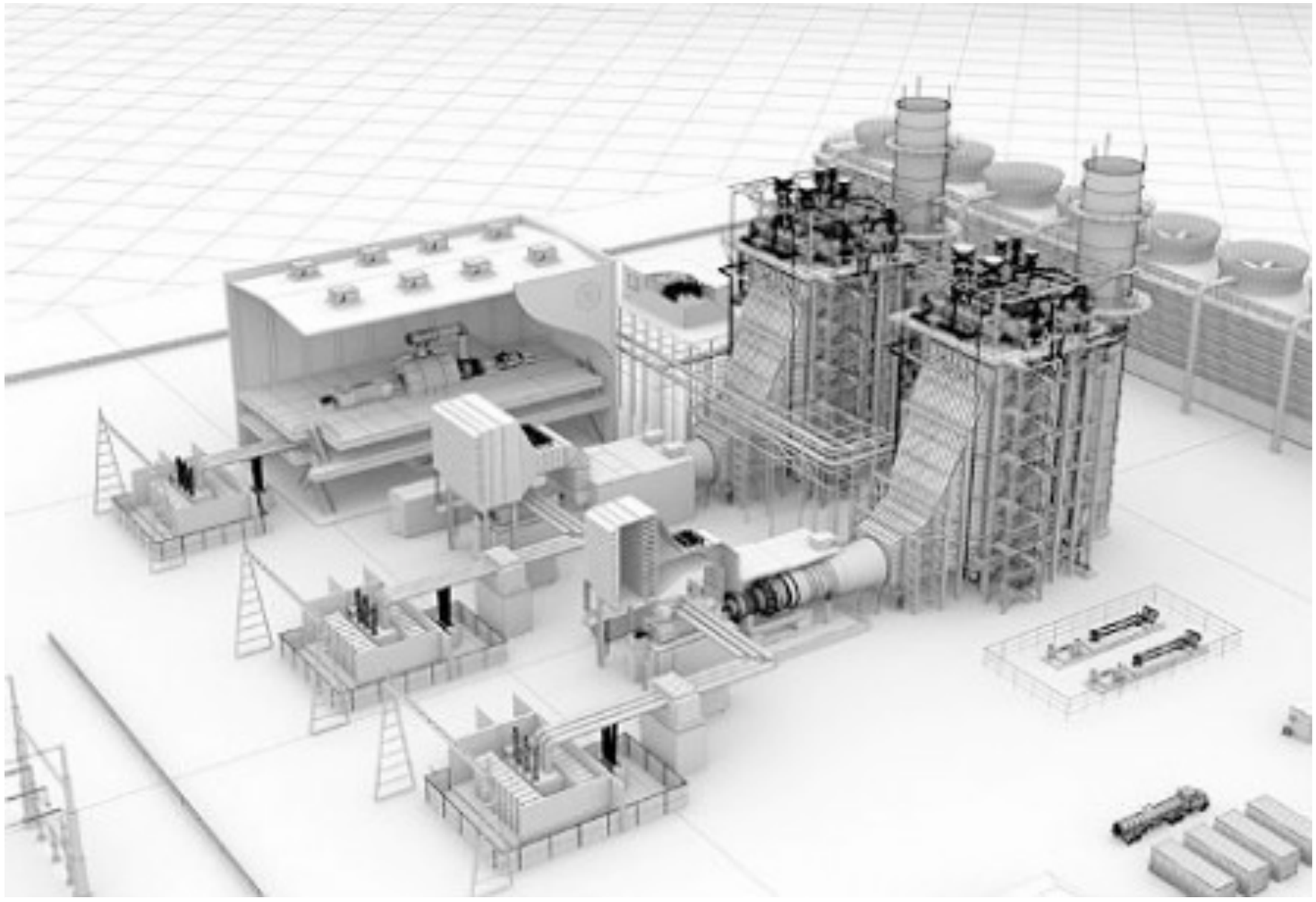


Note: This transfer function diagram indicates the interconnections and functions of control elements but does not show internal details as implemented in the real equipment and reproduced in the model logic. This model logic is not shown.

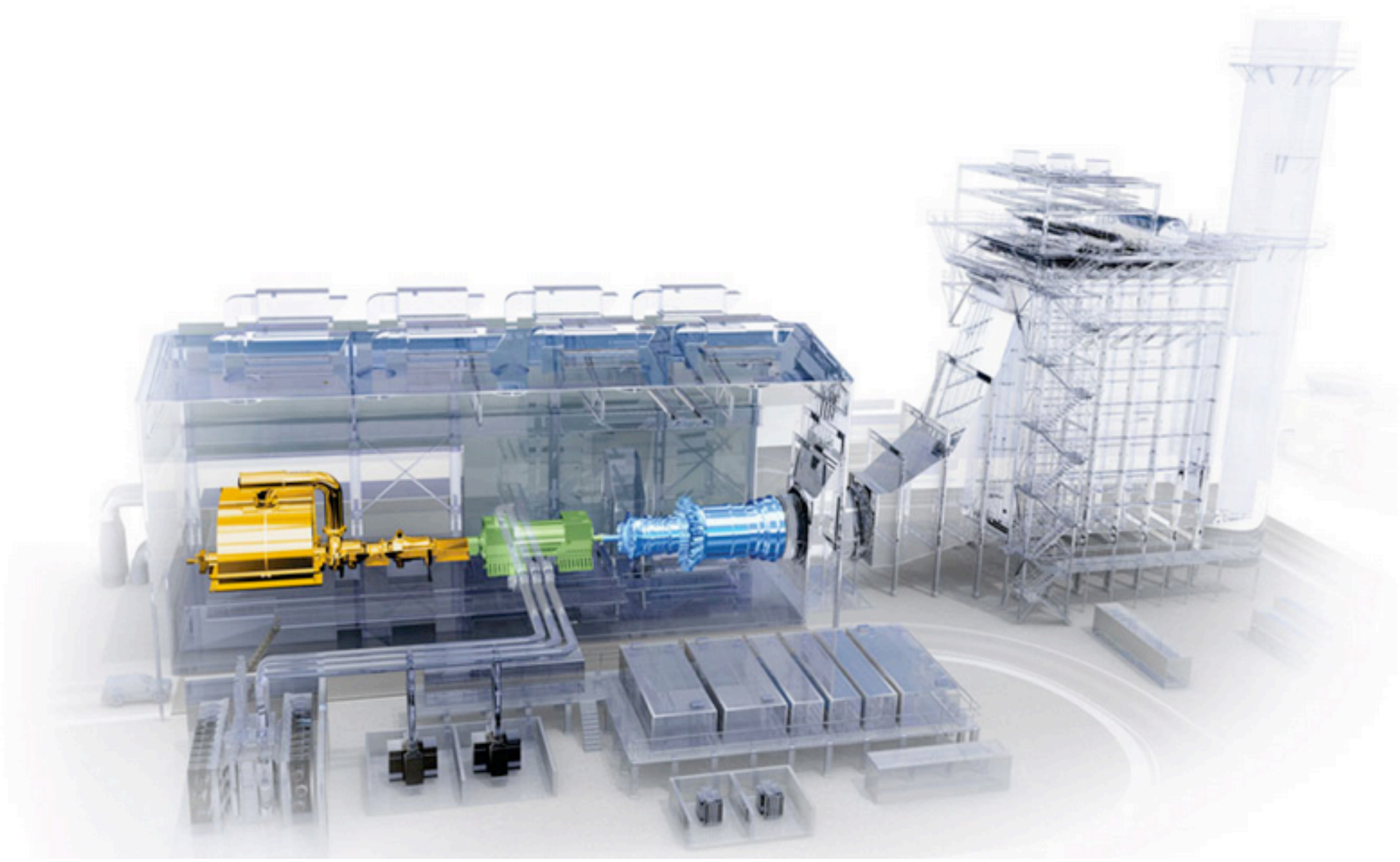
GE 9FA Gas Turbine (255MW)



2+1 combined cycle power plant



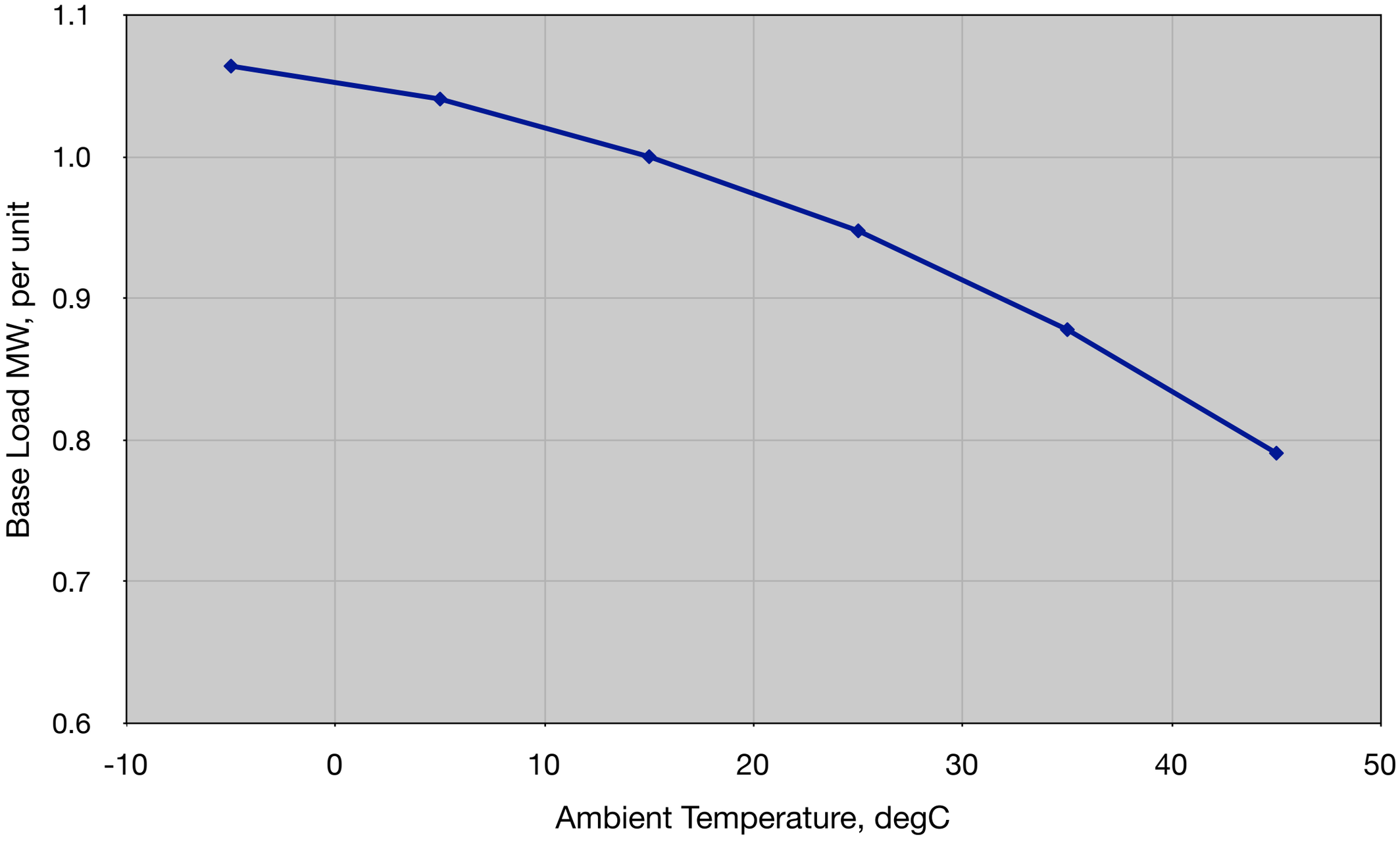
Single shaft combined cycle power plant



Objective of plant control depends on many selections that can be made by the operator

- base load (fuel flow limited by exhaust temperature)
- governing according to droop
- governing with in-plant supervision (preselected load)
- at preselected load and not responsive to system AGC
- at preselected load and responsive to system AGC

7FA Gas Turbine Maximum Power vs Ambient Air Temperature



Need to recognize distinctions among the models we use

Mature / settled
- equipment very fully understood
- long experience *in our field of endeavour*
- synchronous / induction machines / some exc. system

Intermediate / evolutionary / varied experience
- nearly all digital control elements (turbine/exc controls)
- protection / supervisory control elements

Immature / evolving / needing experience
- nearly all renewable power elements
- wind power types 1,2,3,4,.....,n
- PV solar types

Load modeling

A. Critical effect on results of power system simulations

B. The sky is secure / will not fall (though it may rain a lot)

C. We can model what we expect loads to do
- in principle
- not in detail
- such modeling has improved greatly in the last
  10 years as monitoring equipment (PMU / PQube / ...)
  have become available

Understanding of loads will be a continuing process


AIR CONDITIONER HEATPUMP OUTDOOR UNIT

MODEL RXS50KVMA SER. NO. E012384

REFRIGERANT R410A 1.5 kg NET WEIGHT 48 kg

POWER SUPPLY	220-240 V~ 50Hz
CONNECT MODEL	FTXS50KVMA
PROTECTION	IPX4
FUSE AMP.	20 A
DESIGN PRESS. (Hi/Lo)	4.17/2.21 MPa
MAXIMUM CURRENT	15.5 A

	220 V~ 50Hz	
	COOLING	HEATING
INPUT	1430 W	1610 W
CURRENT	6.7 A	7.4 A
CAPACITY	5000 W	5860 W

VALUES ARE FOR PAIRED CONNECTIONS.
PLEASE REFER TO THE TECHNICAL MANUAL REGARDING MODEL COMBINATION, COOLING (HEATING) CAPACITY, AND OTHER ELECTRICAL SPECIFICATIONS.

N81

AS/NZS3823.1.1 (230V~ 50Hz)		
	COOLING	HEATING
INPUT	1430 W	1610 W
CURRENT	6.4 A	7.1 A
CAPACITY	5000 W	5860 W

POWER SUPPLY	220-230 V~ 60Hz

VALUES ARE FOR PAIRED CONNECTIONS.
PLEASE REFER TO THE TECHNICAL MANUAL REGARDING MODEL COMBINATION, COOLING (HEATING) CAPACITY, AND OTHER ELECTRICAL SPECIFICATIONS.

	220 V~ 60Hz	
	COOLING	HEATING
INPUT	1430 W	1610 W
CURRENT	6.7 A	7.4 A
CAPACITY	5000 W	5860 W

OUTSIDE SOUND POWER LEVEL 62 dBA

(LOWER LEVELS MEAN LOWER OUTSIDE NOISE)
THE LEVEL SHOWN ABOVE MAY BE USED TO ESTIMATE WHETHER THE OUTSIDE NOISE FROM THE PROPOSED INSTALLATION OF THIS UNIT WILL BE WITHIN ACCEPTABLE LIMITS.
CONSULT YOUR SUPPLIER BEFORE INSTALLATION.

R410A

DAIKIN INDUSTRIES (THAILAND) LTD.
MADE IN THAILAND 2SB64634-9C

Thank you